Assignment #3

Oracle ESQL/C

KAIST

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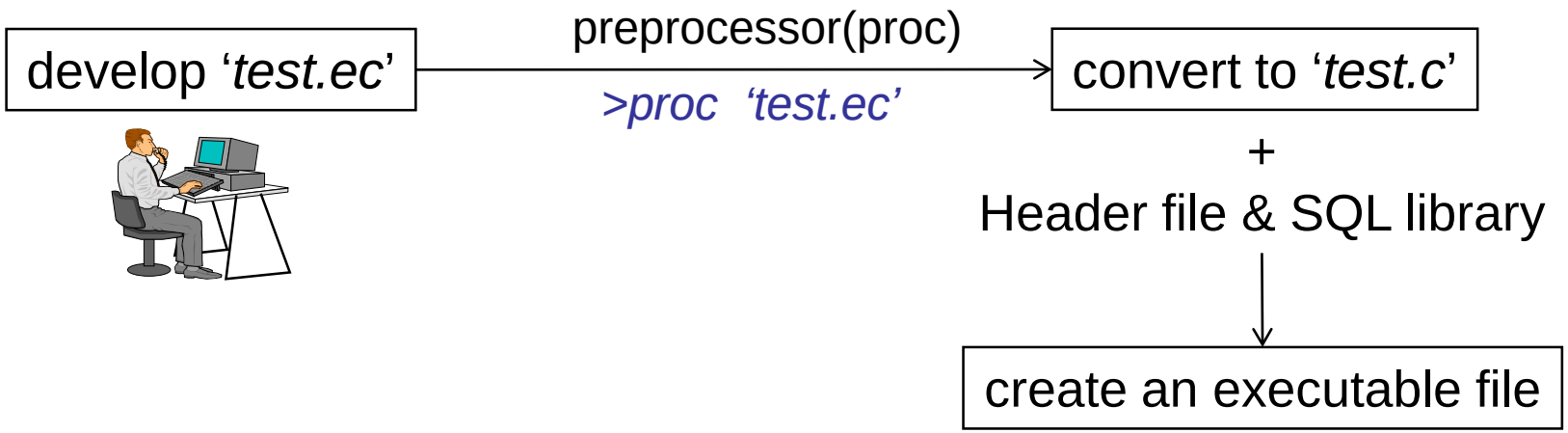
Introduction to Oracle ESQL/C

- What is ESQL/C?
  - Combination of SQL and host language C
    - » C code for general-purpose calculation
    - » SQL for data manipulation
- Processing programs with Oracle ESQL/C



Develop .ec file

Oracle ESQL/C Syntax

- How to write .ec file?
  - The syntax of .ec file follows C syntax except ‘EXEC’ blocks.
  - Include header files, *sqlca.h*
  - Every SQL statement begins with ‘*EXEC SQL*’ and ends with ‘;’
  - All host variables should be placed in declare section
  - Host variables are preceded by a colon : in ESQL

```
Ex)  #include <sqlca.h>
            ……  /*  C code */
     EXEC SQL BEGIN DECLARE SECTION ;
            char studioName[50], studioAddr[256];
            char SQLSTATE[6];
     EXEC SQL END DECLARE SECTION;
            ……. / *  C code */
     EXEC SQL INSERT INTO Studio(name, address)
            VALUES (:studioName, :studioAddr);
```

Declare section

Oracle ESQL/C Syntax (cont'd)

- How to connect to Oracle?
  - EXEC SQL CONNECT :<*username*> IDENTIFIED BY :<*password*> USING :<*tns_name*>;

    » :<*tns_name*> is the tns name in Oracle

    - tns : the structure of storing host address, protocol, port number, service name which you connect to DBMS
    - You already registered tns name 'cs360' in your PC at Assignment#1 ((directory that *Oracle Client* is installed)\network\admin**tnsnames.ora**)

```
ex)  EXEC SQL BEGIN DECLARE SECTION ;
       char *username = "s20150000"; char *password = "TIGER";
       char *tns_name = "cs360";
     EXEC SQL END DECLARE SECTION;
     EXEC SQL CONNECT :username IDENTIFIED BY :password USING :tns_name;
```

Oracle ESQL/C Syntax (cont'd)

- Making cursor
  - EXEC SQL DECLARE <cursor_name> CURSOR FOR <query>;
  - EXEC SQL OPEN <cursor_name>
  - EXEC SQL FETCH <cursor_name> INTO <var_list>;

```
Ex) EXEC SQL DECLEARE execCursor CURSOR FOR SELECT netWorth FROM MovieExec;
    EXEC SQL OPEN execCursor;
    while(1){
     EXEC SQL FETCH  execCursor INTO :worth;
            ……/* C Code */
     }
```

Oracle ESQL/C Syntax (cont'd)

- Modification by Cursor
  - Use 'FOR UPDATE OF' to enable update through cursor
  - 'WHERE CURRENT OF' followed by the name of the cursor

```
Ex) EXEC SQL DECLEARE execCursor CURSOR FOR
            SELECT  * FROM MovieExec FOR UPDATE OF netWorth;
    EXEC SQL OPEN execCursor
     while(1){
            EXEC SQL FETCH FROM execCursor INTO :execAddr, :certNo, :worth;
            if(worth < 100){
            EXEC SQL DELETE FROM MovieExec
                        WHERE CURRENT OF execCursor;
            }
            else{
            EXEC SQL UPDATE MovieExec
                         SET  netWorth =  2* :worth ;
                        WHERE CURRENT OF execCursor };
             ……/* C Code */
      }
```

Oracle ESQL/C Syntax (cont'd)

- Dynamic SQL
  - Used when SQL statements are not known at compile time
  - Using parameters
    - » Parameters can be used in a query string
    - » Bindings are done by 'USING' clause
      - EXECUTE <SQL variable> USING :host-variable[, , ,]

```
Ex) stmt = "DELETE FROM movie
                WHERE length < :lengValue  AND year > :yearValue";
    EXEC SQL PREPARE SQLquery FROM :stmt;
    EXEC SQL EXECUTE SQLquery USING :lengthValue, :yearValue;
```

Oracle ESQL/C Syntax (cont'd)

- Dynamic SQL (cont'd)
  - Cursor in dynamic SQL
    - » Use DECLARE, OPEN, FETCH CURSOR instead of EXECUTE

```
Ex) Stmt = 'SELECT title FROM movie WHERE length < :lengValue' ;

EXEC SQL PREPARE SQLquery FROM :stmt;

EXEC SQL DECLARE CURSOR dCursor CURSOR FOR SQLquery;
EXEC SQL OPEN dCursor using :lengValue;
For(..){
EXEC SQL FETCH dCursor INTO :titleValue;
. . .
}
```

Oracle ESQL/C Syntax (cont'd)

- Error handling
  - SQLCA (SQL Communication Area) structure
    - » must include 'sqlca.h'
    - » struct sqlca {

```
        …
        long        sqlcode;
        struct sqlerrm {
                char sqlerrmc[70];
                …
        }
}
```

  - Ex) using sqlca for error handling
    - » EXEC SQL …; /* error occurred */

```
    printf("sqlcode : %d\n", sqlca.sqlcode);
    printf("error_msg : %s\n", sqlca.sqlerrm.sqlerrmc);
```

sqlca.sqlcode == 1403 : no data
sqlca.sqlcode == 0 : no error

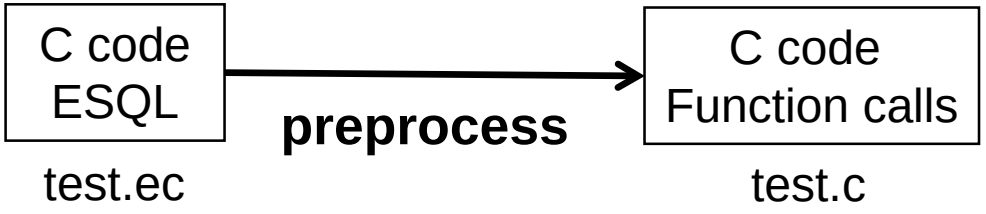
Preprocess

Preprocessing .ec file

- Procedure for preprocessing .ec file in *Windows*

1. In your command prompt, input
   set path = (directory that *Oracle Client* is installed)\BIN
   » Ex) `>set path = F:¥product¥11.2.0¥client_1¥BIN`
2. Go to the directory which has your .ec file
3. Use ‘proc’ command to convert .ec file to .c file
   - ‘proc.exe’ file exists in “(directory that *Oracle Client* is installed)\BIN\proc.exe”

   » Ex) `>proc test.ec`



Preprocessing .ec file (cont'd)

- Example

```
C:₩>set path = F:₩app₩0611₩product₩11.2.0₩client_1₩BIN

C:₩>cd test

C:₩test>proc test.ec

Pro*C/C++: Release 11.2.0.1.0 - Production on 금 3월 27 20:47:01 2015

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시스템 기본 옵션 값이 가지고 온 곳: F:₩app₩0611₩product₩11.2.0₩client_1₩precomp₩
admin₩pcscfg.cfg


C:₩test>dir
 C 드라이브의 볼륨에는 이름이 없습니다.
 볼륨 일련 번호: E863-D3CE

 C:₩test 디렉터리

2015-03-27  오후 08:47    <DIR>          .
2015-03-27  오후 08:47    <DIR>          ..
2015-03-27  오후 08:47             5,491 test.c
2015-03-27  오후 08:17               307 test.ec
               2개 파일               5,798 바이트
               2개 디렉터리  186,759,442,432 바이트 남음
```
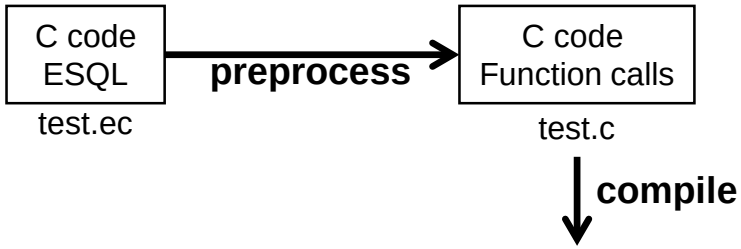

You can download *test.ec* from the course homepage

Compile .c file in 32-bit machines

Compile .c file in 32-bit machines

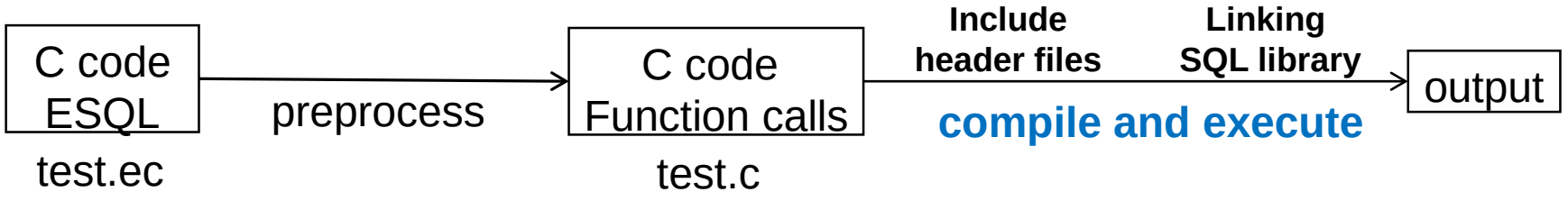
- Compile .c file which come from the preprocessor
- Use the *gcc* compiler
  - » MinGW is *gcc* compiler for window



1. Download & install the MinGW
   - » From http://www.mingw.org/
2. In your command prompt, input
   set path = (directory that *MinGW* is installed)\bin
   - » Ex) >set path = C:\minGW\bin

Compile .c file in 32-bit machines (cont'd)

- Overview – compile .c file by using *gcc* compiler
  - Include header file("sqlca.h") → e.g. ~\product\11.1.0\client_1
    - Exist in "(directory that *Oracle Client* is installed)\precomp\public\sqlca.h"
    - » gcc command: gcc -I[directory path]
      - I (capital letter)
  - Link SQL library ("orasql11.lib")
    - Exist in "(directory that *Oracle Client* is installed)\precomp\LIB\orasql11.lib"
    - » gcc command: gcc -L[directory path] -l[file name]
      - L (capital letter)
      - l (small letter)



Compile .c file in 32-bit machines (cont'd)

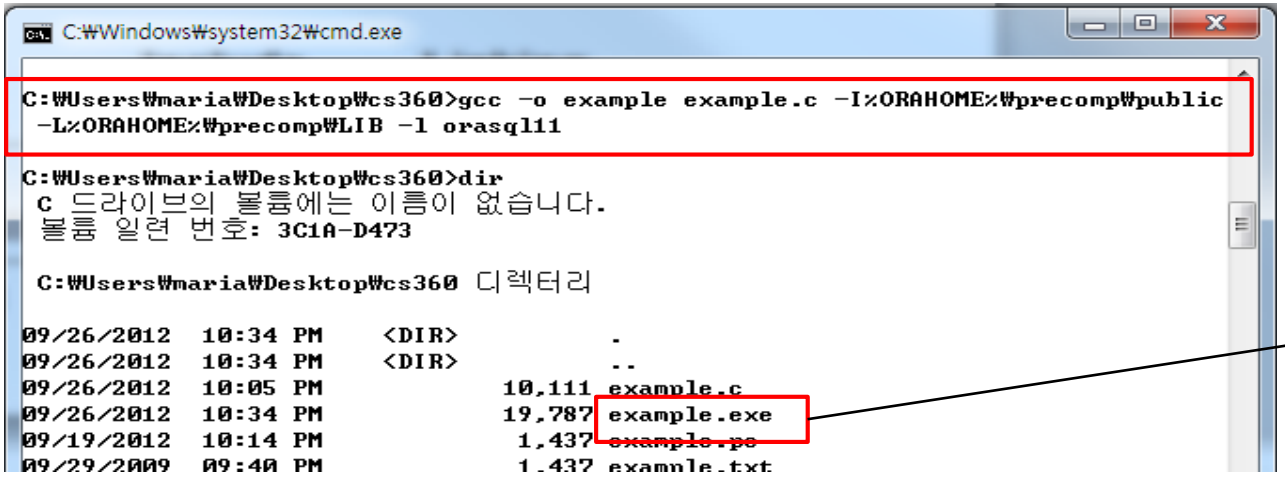
1. Set environment variable "***ORAHOME***"
   - set ORAHOME = (directory that *Oracle Client* is installed)
     - » Example

```
C:\Users\maria\Desktop\cs360>set ORAHOME = D:\app\maria\product\11.2.0\client_1

C:\Users\maria\Desktop\cs360>dir
 C 드라이브의 볼륨에는 이름이 없습니다.
 볼륨 일련 번호: 3C1A-D473

 C:\Users\maria\Desktop\cs360 디렉터리

2012-09-26  오후 10:05    <DIR>          .
2012-09-26  오후 10:05    <DIR>          ..
2012-09-26  오후 10:05            10,111 example.c
2012-09-19  오후 10:14             1,437 example.pc
2009-09-29  오후 09:40             1,437 example.txt
               3개 파일              12,985 바이트
               2개 디렉터리  13,520,228,352 바이트 남음
```

Compile .c file in 32-bit machines (cont'd)

2. Compile by using *gcc compiler*
   - gcc -o [program] [source file]
     -I [directory path which has header files]
     -L [directory path which has library files] –l [library file name]
     » Example

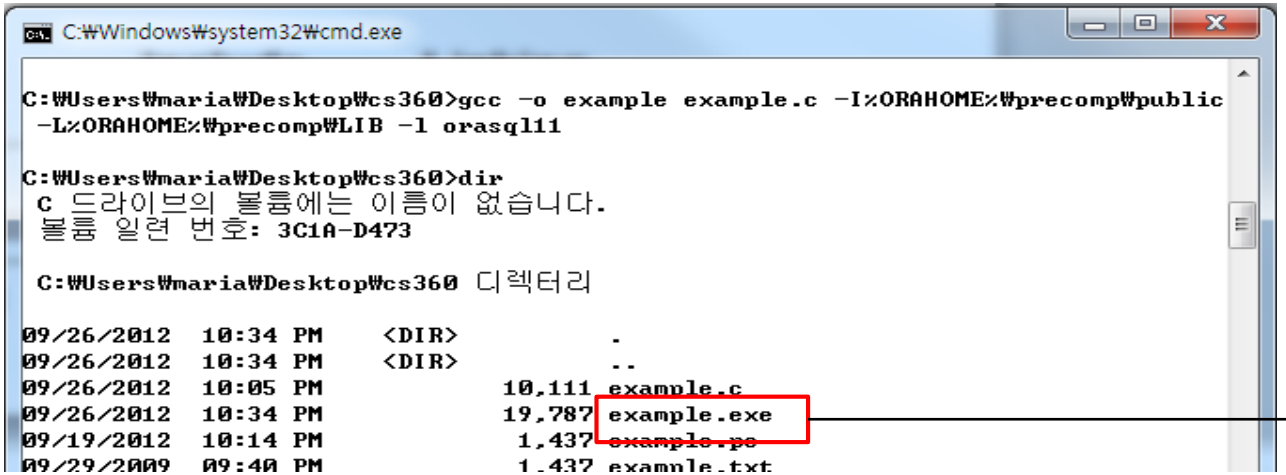
```
gcc -o test test.c -I %ORAHOME%\precomp\public -L %ORAHOME%\precomp\LIB -l orasql11
```



If you success to compile, you can get .exe file

Compile .c file in 32-bit machines (cont'd)

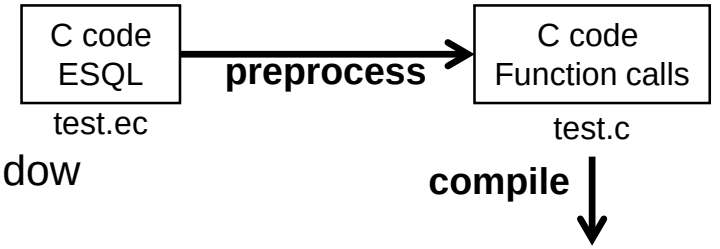
3. Execute the program
   - Finally, you can get ".exe" file if any error doesn't exist
     - » Run & test your program



Compile .c file in 64-bit machines

Compile .c file in 64-bit machines

- Compile .c file which come from the preprocessor
- Use the *"Visual studio"*
  - *Visual studio* is an editor with compilers for window



  - Download & install the "Visual studio 2013"
    - » From http://kftp.kaist.ac.kr/visualstudio.brd?shell=/index.shell:30

번호	파일	글제목	일시	조회
08		· Visual_Studio_Premium_2013_English	14-04-21	717
07		· Visual_Studio_Premium_2013_Korean	14-04-21	1547
06		· Visual_Studio_Premium_2012_English	13-02-06	1305

      - If you have a problem to install, refer http://kftp.kaist.ac.kr/notice._.brd/_3.4.735d/?shell=/index.shell

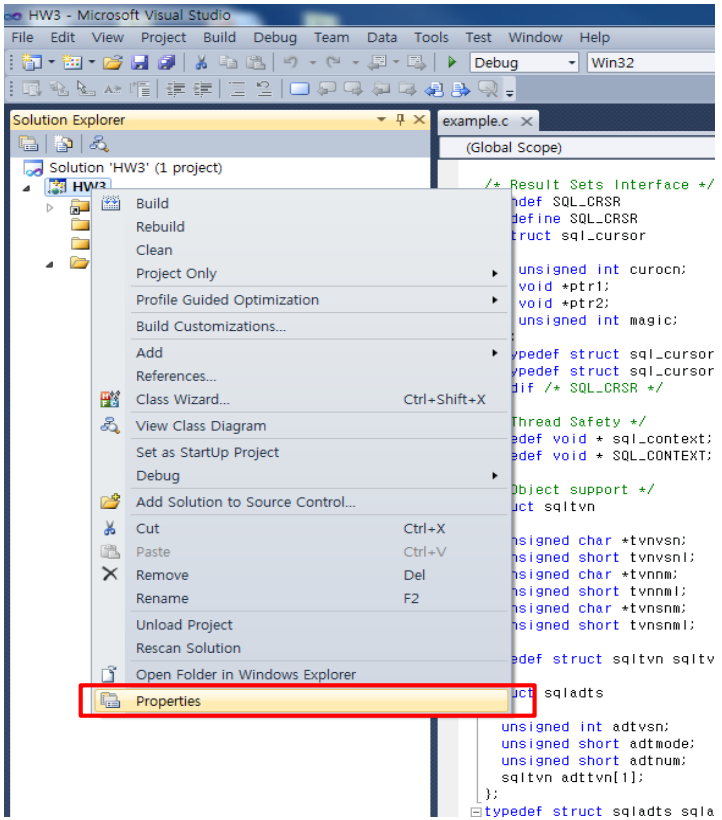
    - » Or from http://www.visualstudio.com/en-us/products/visual-studio-community-vs

Compile .c file in 64-bit machines (cont'd)

- Overview – compile .c file by using *Visual studio 2013*
  1. Make a new project
  2. Add the source file(.c file) which come from the preprocessor
  3. Include header file ("sqlca.h")
  4. Include SQL library ("orasql11.lib")
  5. Compile the source file
  6. Run a executable file and test it

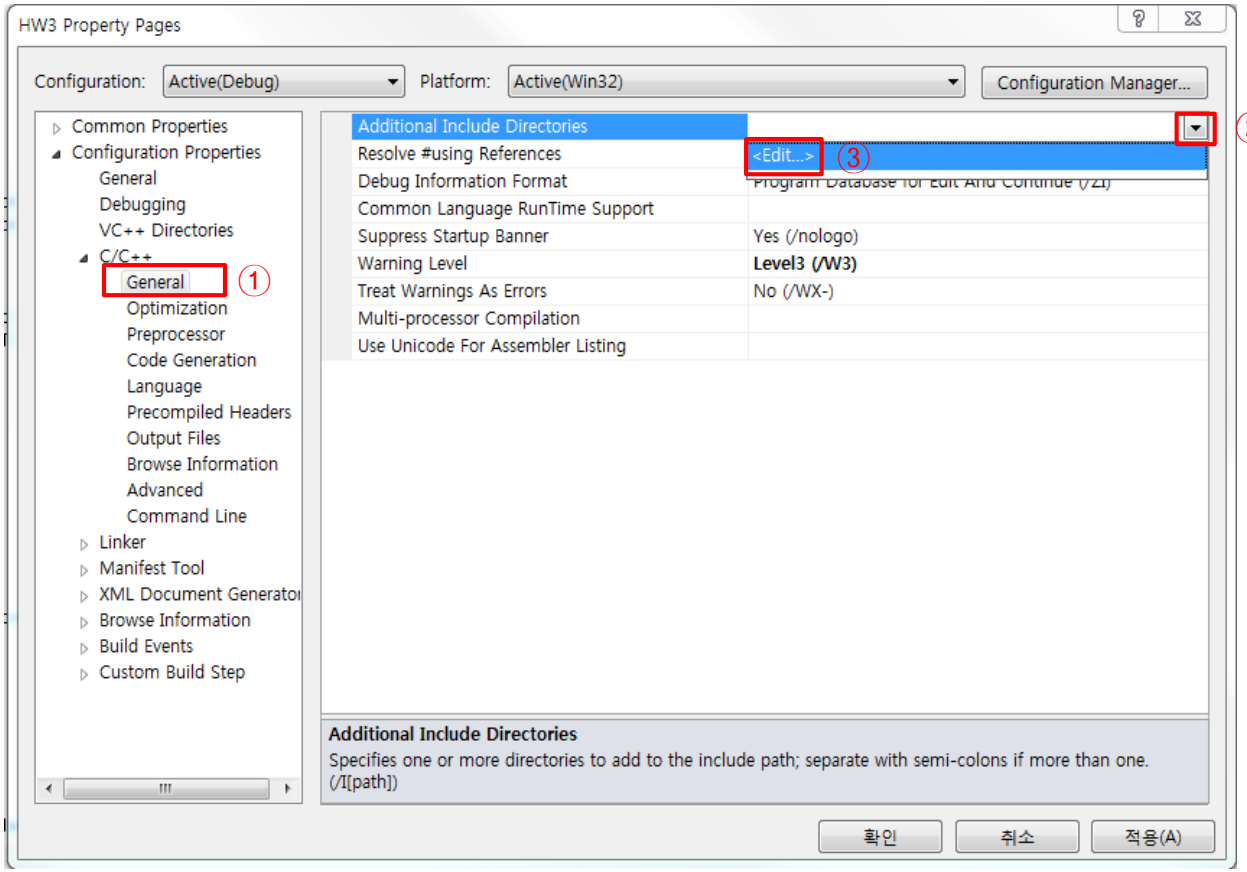
Compile .c file in 64-bit machines (cont'd)

- Procedure in detail – compile .c file by using *Visual studio 2013*
  1. Make the new project
  2. Add ".c file" to project
     - » Ex) Add "test.c" file to project
       - Refer the reference
  3. Select the *properties* of the project like the picture



Compile .c file in 64-bit machines (cont'd)

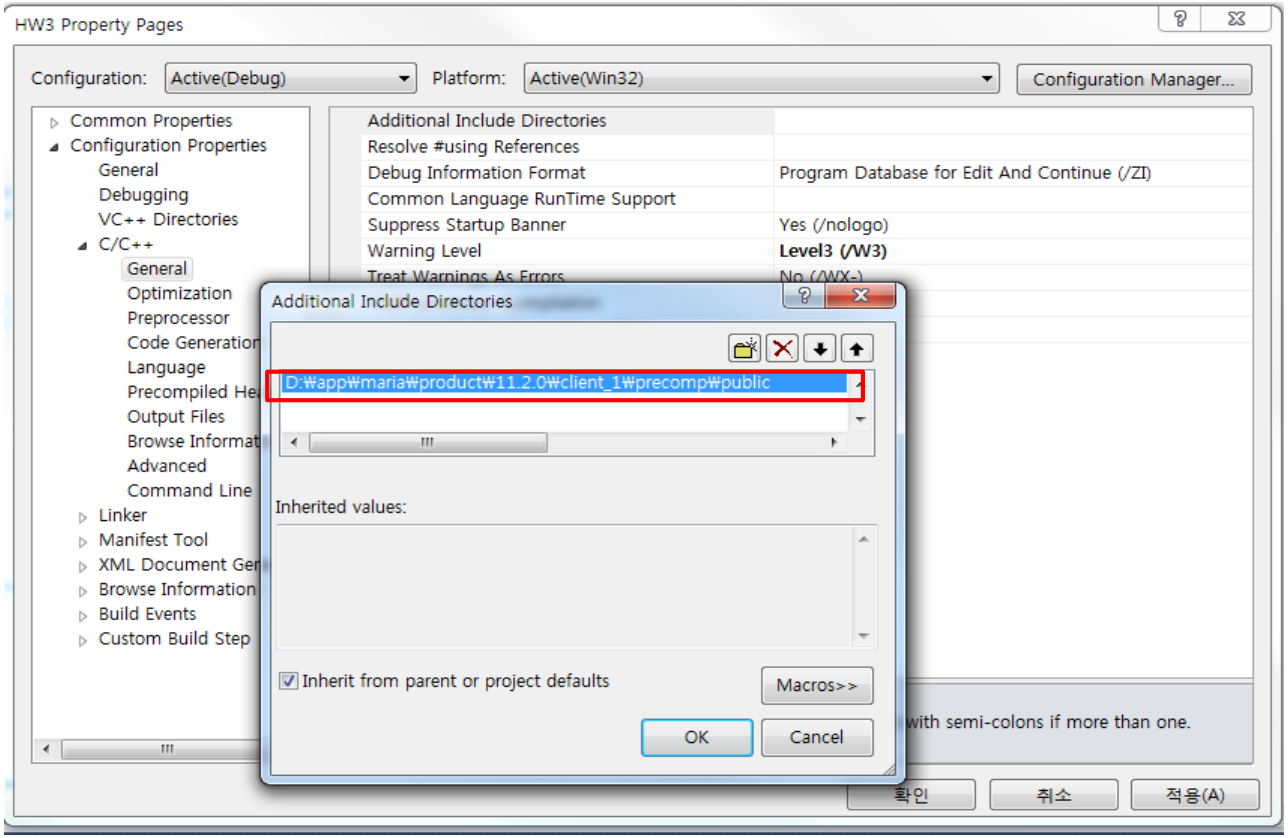
4. Go to the "C/C++" > "General" > select "Edit" in "Additional Include Directories"



Compile .c file in 64-bit machines (cont'd)

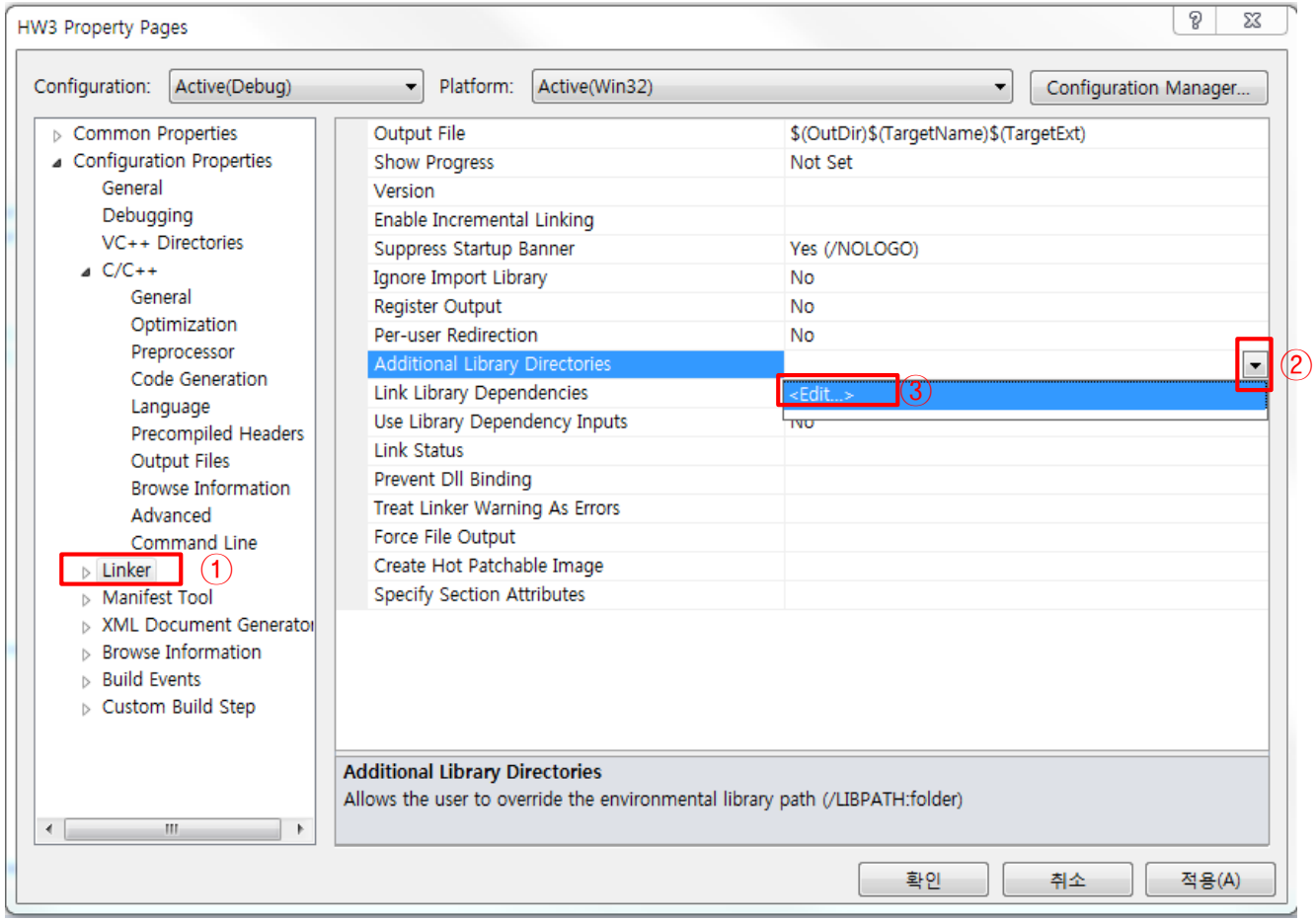
5. Add the path that "(oracle client installed directory)\precomp\public"
   - To add the directory of header files

» Ex) D:\app\maria\product\11.2.0\client_1\precomp\public



Compile .c file in 64-bit machines (cont'd)

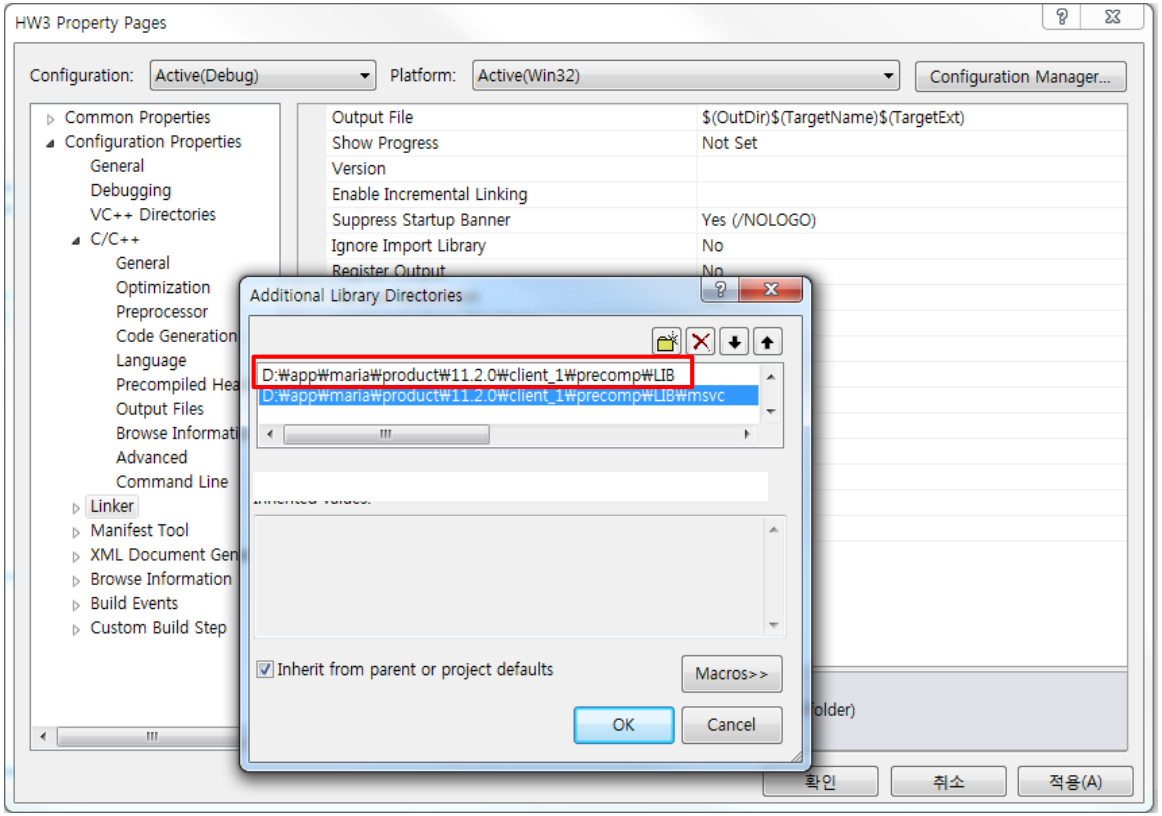
6. Go to the "Linker" and select "edit" in the "Additional Library Directories"



Compile .c file in 64-bit machines (cont'd)

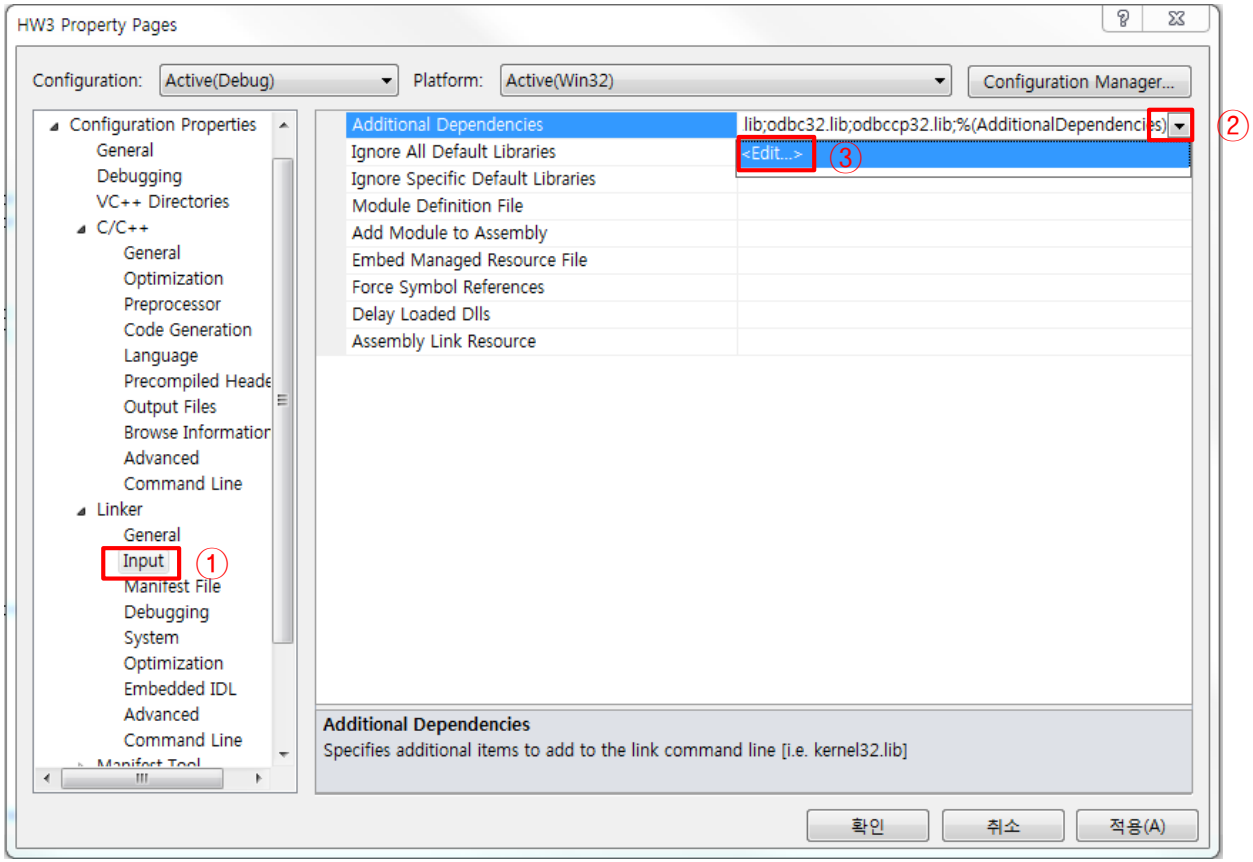
7. Add the path that "(oracle client installed directory)\precomp\LIB"
   - To add the directory of library files

» Ex) D:\app\maria\product\11.2.0\client_1\precomp\LIB



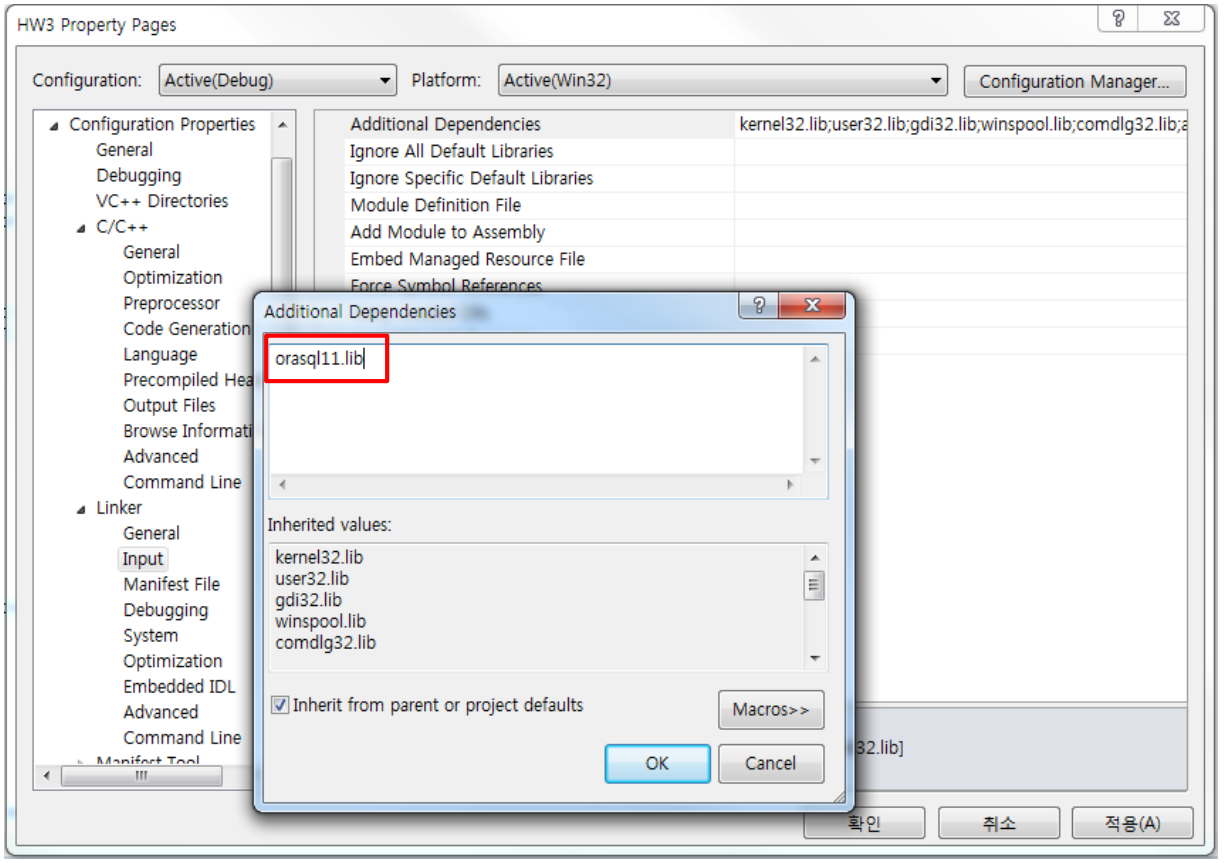
Compile .c file in 64-bit machines (cont'd)

8. Go to the "Linker" > "Input" and select "edit" in the "Additional Dependencies"



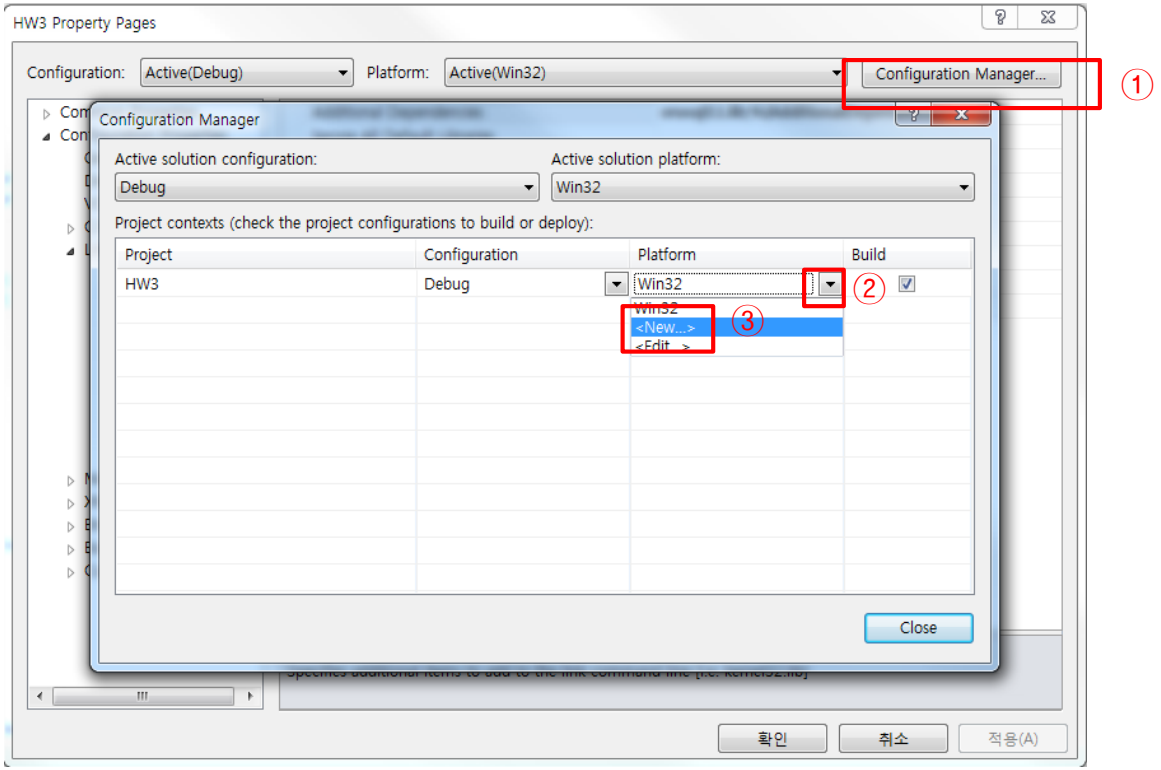
Compile .c file in 64-bit machines (cont'd)

9. Add a library name that "*orasql11.lib*"



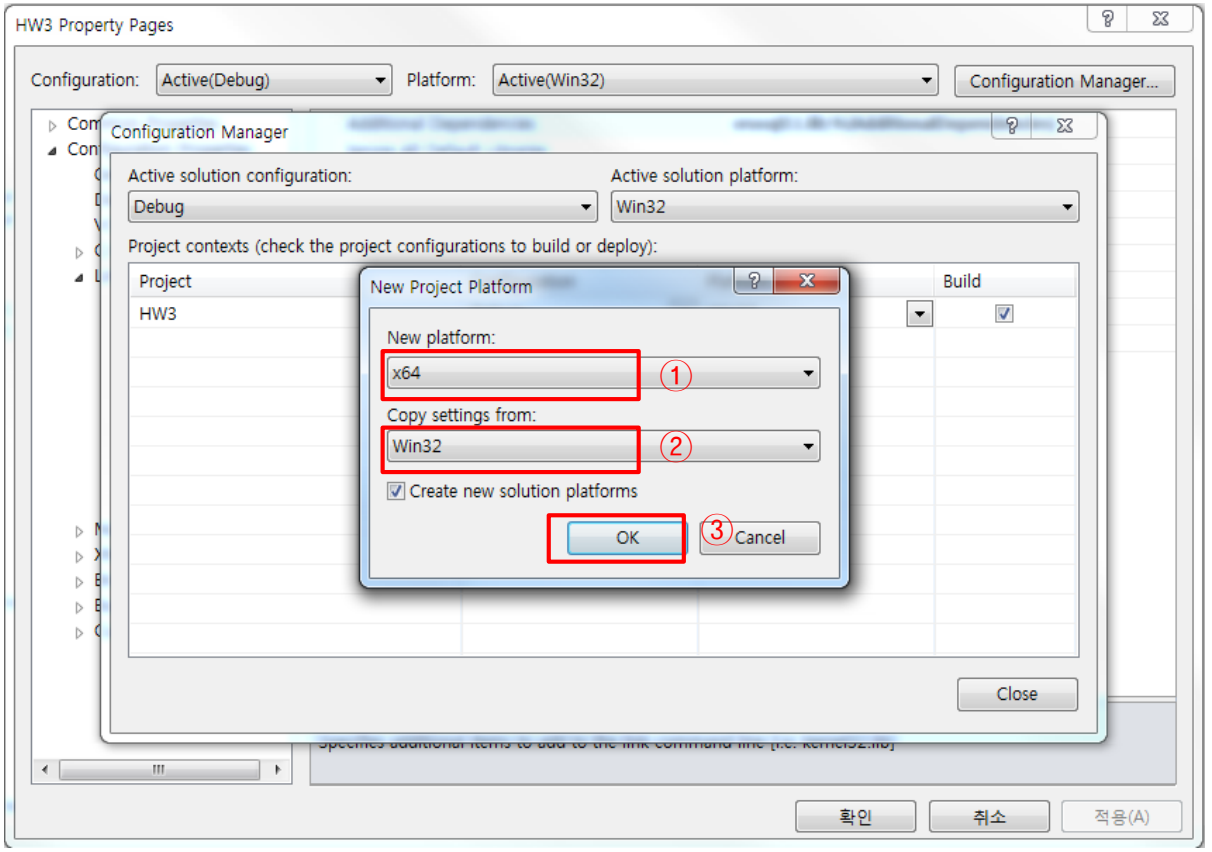
Compile .c file in 64-bit machines (cont'd)

10. Now, we finish including header files and library files
    - » We need more steps to fit a 64-bit environment
11. Select the "configuration manager" and select "new" in "Platform"



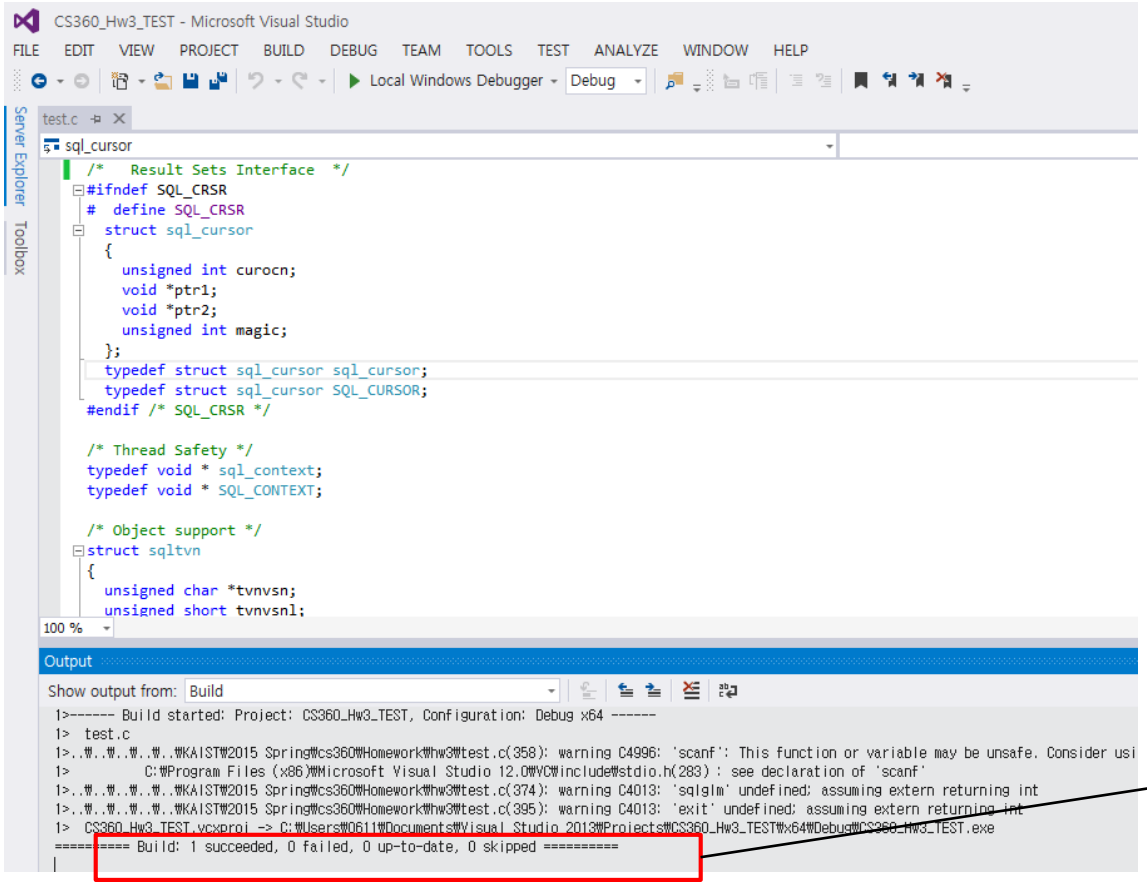
Compile .c file in 64-bit machines (cont'd)

12. Set the "new platform" to "x64" and also "copy settings" to "Win32"
13. Click OK button



Compile .c file in 64-bit machines (cont'd)

14. Press the keys "Ctrl"+ "Shift" + "b" to compile



If you get "0 failed",
you success to compile

Compile .c file in 64-bit machines (cont'd)

15. To run the executable file, press the keys "Ctrl"+ "F5"
    - » Then you can see the program like below picture

- » The executable file is in "(directory that *the Project* is made)\x64\Debug\"
  - Ex) C:\Users\cs360\Documents\Visual Studio 2013\Projects\CS360_Hw3\x64\Debug\Hw3.exe

Assignment #3

Submission

- Due
  - April. 8, 12 p.m.
  - Delay is not accepted
- Submission standard
  - [student ID].ec
  - [student ID].c
  - [student ID].exe (executable file)
  - Archive them into [student ID].zip and upload it to course homepage
- Evaluation
  - You will get points if your source codes are complied successfully
  - You will get points if your program find the right answers and is written correctly
  - Do not cheat others. Both of them will get no point

Purpose of the assignment

- Purpose
  - Learn how to programming ESQL/C and how to compiling the code

- What should you do?
  1. For given example database, write .ec file for each questions
  2. Preprocess .ec file and get .c file
  3. Compile .c file and test the program

Example Database

- Table creation
  1. Download *HW3db.sql* from the course homepage and copy it to (directory that Oracle Client is installed)\BIN
  2. Use the *SQLPlus* and perform the command *@HW3db.sql* or *start HW3db.sql*

Example Database (cont'd)

- Data schema

  student(stuID , stuName, year, department)

  course(courseID, title, department, credit, profID)

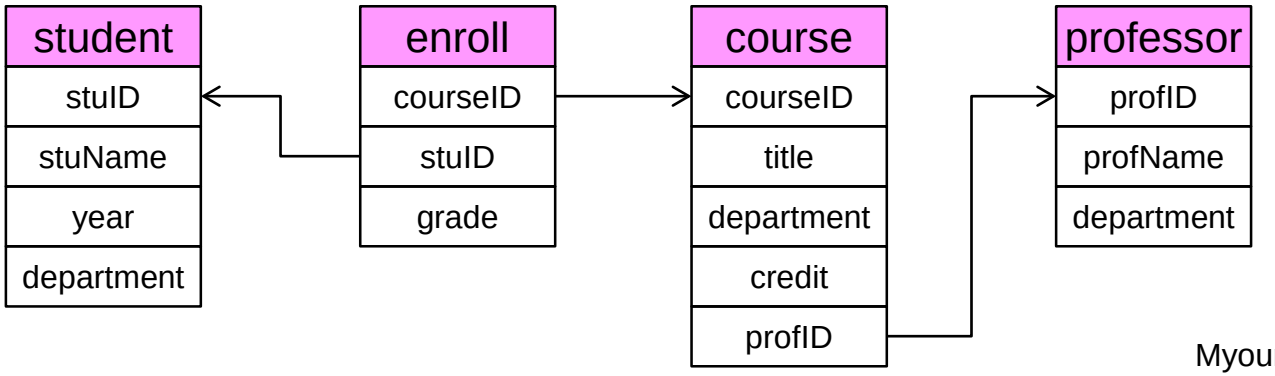
  enroll(courseID, stuID, grade)

  professor(profID, profName, department)

  char(30) : stuID, stuName, department, courseID, title, profID, profName

  char(4) : grade

  integer : year, credit



Program requirement

- Main menu
  - » Ask a user to enter '*ID*' and '*Password*' to connect the oracle server
  - » Ask a user to enter a question number
  - – Example of program UI

```
ID : 20150000
Password : TIGER
-------------------------------
CS360 HW3 ESQL/C
-------------------------------
Please enter solution number(1~4), quit(5) : 5
```

Blue texts are user inputs

Program requirement (cont'd)

- Q1. Use Cursor
  - For each course the student with *studID* = '**s20151436**' enrolls, **print** the **name** of professor who offers the course, the **title** of the course and the **grade** he/she received
    - » Example output

```
Please enter solution number(1~4), quit(5) : 1
s20151436 student information:
---------------------------------------------------------
Professor          Course title          Grade
---------------------------------------------------------
  ....               ....                ....
```

Blue text is a user input

Program requirement (cont'd)

- Q2. Use Cursor
  - For each course, let P be a proportion of grade '**A**' in all grades. If P<0.3, **print** the **title** of the course and the value **P**
    - » Example output

```
Please enter solution number(1~4), quit(5) : 2
-----------------------------------------------------
title        ratio of 'A' grades
-----------------------------------------------------
  ....       ....
```

Blue text is a user input

Program requirement (cont'd)

- Q3. Use Dynamic SQL & Modification by Cursor
  - **Request** a **student ID** and a **course ID**. If the input is correct (i.e., there exists a course with course ID, and a student with student ID has taken that course), **change** the grade 'A' to 'B' or 'B' to 'A'
  - **Print** the result if exists. Otherwise, print "No such data exists"
    - » Example output

```
Please enter solution number(1~4), quit(5) : 3
Student ID : s20150000
Course ID : cs360
-----------------------------------------
Course title        Grade
-----------------------------------------
Database            'A'
```

Blue texts are user inputs

Program requirement (cont'd)

- Q4. Use Dynamic SQL (use Cursor)
  - **Request** a **SQL statement** which returns a set of tuples with a single attribute whose type is char(30)
    - » EX) SELECT stuName FROM student WHERE year > 2012
  - **Print** appropriate results
    - » Example output

```
Please enter solution number(1~4), quit(5) : 4
SQL : SELECT stuName FROM student WHERE year > 2012
----------------------------------------
…..(result)
```

Blue texts are user inputs

References

- Lecture note
- Text book
  - 9.1, 9.2, 9.3
- Example code ‘test.ec’
  - http://docs.oracle.com/cd/A97630_01/win.920/a97251/ch5.htm#1037153
- How to create a “c file” project in Visual studio
  - http://www.zealfortechnology.com/2013/06/compile-c-program-using-visual-studio-2012.html